

Despite the fact that these AM bandwidth allocations were never intended to accomodate the use of digital broadcast signals, IBOC takes advantage of this allocated spectrum space in order to saddle an AM carrier with continuously modulated sidebands across a +/- 15 kHz bandwidth, carrying the station's digital data streams on the first- and second-adjacent channels -- which can hardly be described as "In-Band, On-Channel".

The results of this kind of jury-rigged system have become well-known and well-documented. The IBOC sidebands completely destroy reception of the first-adjacent channels across a station's entire coverage area, and fill the second-adjacent channels with a constant interference which can also cause reception of neighboring stations to be seriously impaired. And with the sideband linearity problems that many directional AM antenna arrays exhibit, additional receiver-induced interference can greatly harm reception of channels up to 40 kHz away from an IBOC station's carrier frequency -- as listeners of IBOC stations such as 710 WOR have experienced at distances even beyond the station's 0.5 mV/m coverage area.

Now, as if these problems associated with the daytime use of IBOC aren't great enough, nighttime use of IBOC is being considered for approval as well -- despite the fact that it is well-documented to cause destructive interference, even beyond the borders of the USA into neighboring countries, whose stations will also suffer from this interference. The justification for this appears to be based solely upon the testing of a handful of stations, as received on a handful of radios, in a handful of locations. But when we are dealing with thousands of stations, millions of listeners, and billions of receivers, is a handful really enough?

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The FCC must not allow IBOC to be implemented on the AM broadcast band. I've listened to numerous test stations running the IBOC system and they cause serious interference to first and second adjacent channels especially at night.

Example: WSAI AM 1530 from Cincinnati obliterates WWKB AM 1520 in Buffalo at night even if you are only ten to 15 miles west of their directional signal.

AM 850 in St. Louis wipes out WHAS AM 840 from Louisville throughout most of Illinois and Indiana where otherwise in many of these places you could listen to WHAS both day and night.

IBOC will render most lower power AM stations as useless while only the highest powered stations will be able to get decent coverage.

I also support the Amherst Alliance filings on IBOC.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C. 20554

In the Matter of Amendment of Part 73 of the)	
Commission's Rules to Permit)	Docket Number: MM 99-325
The Introduction of Digital Audio)	Reply Comments
Broadcasting in the AM and)	
FM Broadcast Service)	

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I, Frederick R. Vobbe, am a qualified broadcast and communications engineer with thirty-six years of service in the broadcast industry. I am a licensed and practicing amateur radio operator, radio/TV/electronics experimenter, and radio listener. My professional duties include Vice President and Chief Operator of an NTSC and DTV television stations, Communications Officer for the Allen County Office of Homeland Security, Chairman of the Lima/Allen County E.A.S. district, and Chairman of our state amateur repeater coordination body. I have also published a monthly magazine on tape for blind radio enthusiasts continuously since 1985, and jointly operate a web site and various E-mail lists on the topic of radio/TV technology and listener support. Along with my positions in engineering I have also been employed as Operations Manager of several radio stations, and have served as an advisor to broadcast stations acting in fields of program and finance.

Interference Issues

NRSC Mask

Many of those commenting stated that IBOC transmissions meet the NRSC mask set forth in the FCC rules. The NRSC mask was designed for analog transmissions, not digital.

The NRSC mask is acceptable for analog program content with random and varying analog audio peaks. However, digital transmissions fill the entire mask area. To compare an

analog transmission inside an NRSC mask with a digital transmission inside the mask is like saying that 1 cubic feet of aluminum (analog) weighs the same as 1 cubic feet of lead (IBOC) because they are both the same height, width, and depth.

Digital transmissions do not conform to the same characteristics as analog transmissions. While the analog will fill the mask at various points in time, the digital mask fills the entire area immediately. A good test of this would be to take a 500 ms sample of an analog transmission, then digital transmission. You will note that digital transmission is denser, and fills the bandwidth. While the analog fills random points depending on program density and levels of modulation.

The non-engineer should look at digital as a 16-ounce glass filled with water. Think of analog as that same glass but filled with large ice cubes and water. When you pour the water into a beaker calibrated to ounces, the "digital" water would give you 16-ounces of liquid. But the "analog" water would yield significantly less liquid, until such a time as the ice all melted.

When measurements have been made on digital RF signals they have allowed the "ice to melt" in the analog world, waited till they have had enough random peaks of modulation to display in the mask. Then they have measured the digital, (which fills up almost instantaneously), and emphatically state that the two signals are alike. This is simply a misrepresentation.

Receivers

The larger majority of AM receivers do not have the sophisticated band pass capabilities to reject signals in excess of 5 kilohertz. For example, in a stock GE "Superradio III" portable radio, the receiver normally captures transmitted signals 5 to 8 kilohertz either side of carrier. Under analog conditions this is acceptable. Of the sixteen radios that I own, both in dash car radios and portables each have similar characteristics. None of the radios I own possess a method in which to exclude the IBOC signal and leave an unaffected analog signal.

Although a radio station may employ the NRSC mask, I do not know of any large number of receivers that employ such a mask as part of the normal circuitry. There are radios that employ high quality band filtering yet these receivers are the exception rather than the norm

for the average citizen. Since there is not a filtering at the receiver stage, although stations employ a NRSC mask, the end user will still receive interference in the form of constant digital hash.

Exemptions to Interference

I am concerned when the Commission starts to apply "exemptions" to real interference issues from IBOC. The Commission may be drawn into serious legal questions in the future.

If the Commission agrees with the idea that IBOC interference is acceptable in the scope of furthering technology, the Commission would logically, and without challenge, have to accept interference from ...

- Broadband over Power Lines.
- Devices and transmitters in excess of the limits specified in CFR 47, Part 15
- Low Power AM stations.
- International broadcaster interference.

In each of the above example I could easily show a benefit to citizens of the United States. But the Commission needs to ask it's self, does the need for cool technology outweigh what is a reasonable interference criteria?

In short, once the Commission allows the argument that interference is acceptable, then the Commission would be hard pressed to restrict other forms of interference without giving the appearance of tipping the scales.

The Commission needs to take the stand that NO INTERFERENCE is the standard. Any implementation of IBOC transmissions must adhere to this criteria without question. It is the only fair that everyone operate and live by the same rules.

Second Adjacent Interference

Much has been said about 1st adjacent interference. That is, a station operating on 710 kilohertz interferes with stations on 700 kilohertz and 720 kilohertz. In comments I wrote earlier, I noted 1st adjacent interference while driving toward Chicago, Illinois, during very severe weather. My radio was a stock GM radio in a 2001 Buick Century. I could not hear the weather reports given on WGN-720 at the time due to the IBOC transmissions of WOR-710. Prior to this event, and dating back to the mid-1970s, this was never a problem.

However, there are also cases of interference to the 2nd adjacent. 2nd adjacent IBOC was documented in the original test reports produced by iBiquity. Unfortunately, anyone reading those reports, and the NRSC, who were responsible for evaluating them, glossed over the interference issues.

Out of four test receivers, three showed moderate to severe impairment to reception when subjected to 2nd adjacent IBOC at 0 dB D/U. The only receiver that was not significantly affected was a Delphi car radio. Oddly, it was the Delphi car radio iBiquity chose to use in their interference studies. Is this a fair representation?

The Delphi radio, although a decent radio for most consumer applications, is not the average radio used by the American public. Using the radio with the best possible rejection, and not introducing the radios used by the larger majority of the public is a misleading test.

The susceptibility to adjacent channel interference depends on the receiver's IF filter characteristics. A receiver with relatively good 1st adjacent rejection is not likely affected by 1st adjacent IBOC. Receivers without a good 1st adjacent rejection will be affected because it appears as co-channel noise. The larger majority of AM receivers in the United States today have poor to very poor 1st adjacent rejection. These receivers are affected by analog interference, and adding IBOC creates an intolerable situation.

If the IBOC is on the 2nd adjacent, the IF filters will suppress most of the artifacts. 2nd adjacent rejection is better due to the fact that the IF filter roll-off is greater, so it takes out the analog interference. But because of the width of the IBOC side-band that appears on the 1st

adjacent, we find that the 2nd adjacent is compromised. And indeed, there are cases where reception has been compromised by the IBOC digital signal.ⁱ

The Commission should insist that an average of commonly sold radios, instead of a benchmark of a certain model, be used in receiver tests. Receiver tests should be conducted by an independent party with no ties to either the pro or anti IBOC platform.

Referring to iBiquity's own filing with the Commissionⁱⁱ, iBiquity states that receiver issues will bear on the level of interference that people will receive.

Risk To Public Safety

During the power blackouts in the Midwest and Northeast, TV was useless, and many smaller radio stations were off the air. The public flocked to the big News Talk Stations like WJR (760 Detroit), WOWO (1190 Fort Wayne), WTAM (1100 Cleveland), WTVN (610 Columbus), WLW (700 Cincinnati), and the list goes on and on.

In fact, Canadian stations such as CKLW (800 Windsor Ontario), CFCO (630 Chatham Ontario), were also important for needed information. Stations like these had facilities to operate on backup power and the staff to report what was going on. However, their voices would have not been heard due to IBOC interference!

In the examples above, due to analog carrier levels, the IBOC interference can be reasonably calculated. The end result is that WJR would not be heard reliably due to WSB (750 in Atlanta), and WABC (770 in New York). WOWO would be compromised from WHAM (1180 in Rochester), and both WCHB (1200 in Inkster) plus WOAI (1200 in San Antonio). WLW would be compromised from WOR (710 in New York), as it has on numerous times during nighttime tests.

It was noted during the WLW and WOR tests that the "hissing" noise from IBOC was easily heard over a 1,000 miles away, and affected the reception of other stations, although it was hard to hear the analog broadcasts of either station. Again, I would refer the Commission to the difference of a signal with a constant modulation level (digital) versus one of varying and random peaks (analog).

Another demonstration of this factor was reported in a broadcast E-mail list where a person in California reported, *"I monitored the original WLW tests while living in southern California. While I could not hear WLW on 700 due to KALL, the IBOC digihash was clearly audible on adjacent frequencies, especially on the "splits" between 690-700 and 700-710."* ⁱⁱⁱ

While it can be debated that there are no radio stations on the air between standard 10 kilohertz broadcast stations, this statement does prove that the IBOC signal is robust enough to propagate thousands of miles and mix with the side-band information of an analog station.

It is easy to see that the more stations get on the air, the worse the situation gets. And my examples just address "big gun stations", stations with 50,000 watts. When all the smaller stations, such as the thousands of 5,000 watt and below facilities commence IBOC transmissions, there will be no fringe service areas anywhere. What will be the impact to all the small 1,000 watt broadcasters, who have been crying about analog noise levels for years?

One can reasonably calculate that noise levels on higher power channels will increase proportionally to the power levels. This removes usable signal from both the co-channel and 1st adjacent channels.

The Commission notes in it's own report¹, and I quote, *The Commission's role in ensuring that broadcasters fulfill this obligation is set forth in section 1 of the Act, which declares that the Congress created the Commission "for the purpose of promoting safety of life and property through the use of wire and radio communication"*.

As I write these comments, this nation is faced with even more attacks from terrorists. The news media is avidly reporting that we will be attacked, and continue to face attack starting before our national elections. Is the Commission prepared to restrict the efficiency of emergency information?

The blackout in the eastern part of the nation, September 11th 2001, severe weather, these are all situations where radio is needed to inform the public in times of emergency. It does not make sense to compromise a pathway to the public, and it would be irresponsible of any public official to suggest that we do so.

¹ http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-129A1.doc page 11, paragraph 27.

Service Areas

Many of those who commented stated that they are only concerned about their local service area, an area roughly 50 miles in radius from the transmitter. In the example above, that would mean that while WOR listeners enjoy a good quality signal, persons like myself would be restricted from listening to WLW or WGN. After all, the interference does not stay within the Grade A.

Several parties commented that a normal broadcast station's business plan does not take into account skywave or Grade B listeners and service. I respectfully submit to the Commission that this omission might be grounds in which to request these stations operating with 50,000 watts analog to drop their power to levels of 1,000 watts to 5,000 watts. There is no need for a 450 mile protection any longer if there is no intention to serve it.

Finally, during the past year I have monitored some of the stations testing IBOC both with an assortment of receivers^{iv}, and a Tektronix 2712 (s/n: B021278), and Link Communications CSM-1000 (s/n: 1377BH) spectrum analyzers. I found that while the analog transmissions of all but one of the 49 radio stations fit nicely in the NRSC masks.

Of the stations transmitting IBOC, each of the stations exceeded the suggested IBOC mask. The stations digital carriers were wider than the mask. One of those stations not only exceeded the mask but the digital carriers were about 9 dB out of symmetry. In checking the station's parameters in the Commission's database, and confirming operations with the station, the station was operating non-directional at the time. I hesitate to think what the directional component would look like.

Attached to my reply comments is a report^v by Jeff Littlejohn, who was Senior Vice President of Engineering for Clear Channel Communications. In all my monitoring cases, the real world observations mirrored what Mr. Littlejohn reported.

The bottom line is that interference is NOT acceptable, no matter what the justification.

International Relationships

Persons who have commented have focused on domestic, United States broadcasters. I feel that the Commission should be responsible to our neighbors to the north, south, and the Caribbean. Canada and Mexico have many AM stations on the air. Interference to stations in Canada and Mexico could lead to problems with present treaties.

Further, interference to countries such as Cuba could lead to a new wave of high power jamming of United States broadcast stations. While the Commission might feel safe in interference levels to FCC licensed station, our neighbors might find it offensive. They may choose to take retaliatory actions unacceptable to present U.S. licensees and place the Commission in the position of having to resolve a conflict.

The Commission would be placed in the dubious position of having responsibility for the financial failing of U.S. broadcast station by promoting the conflict. The Commission, as a regulation body, should insure the protection of each U.S. broadcasters from interference, and be wise in realizing the political consequences of causing interference to Canadian, Mexican, and Caribbean broadcasters.

Contradictions

The Federal Communications Commission has stated that the occupied AM bandwidth shall be limited to 20 kHz. The Federal Communications Commission should restate this to say that the signal must comply with the NRSC II mask. For example, the power spectrum must fall below -25 dBc from 10.2 to 20 kilohertz from the carrier, below -35 dBc from 20 to 30 kilohertz, and so on.

The term "occupied AM bandwidth" is not correct. The definition of the term should be that bandwidth which contains 99% of the signal power, or, more precisely, 0.5% of the total power is below the lower limit of the occupied bandwidth, and 0.5% is above the upper limit.

The occupied AM bandwidth has to be considerably less than 20 kilohertz or it wouldn't meet the mask. The question that needs to be asked is how much? The answer depends on the program content, amount of audio processing, whether standard pre-emphasis was used, and

other factors. When you take all this into consideration, a conservative figure would be 15 kilohertz.

When you add digital information to that carrier it is easy to see why we have issues in the adjacent channels. IBOC's design is to place the digital information on the analog signal at 10-15 kilohertz from the carrier. These "primary digital sidebands" have a total power of -13 dBc. They contain about 5% of the total signal power. Therefore 95% of the signal power is contained within the central 20 kilohertz so the occupied bandwidth is more than that.

Since the spectrum of the digital side-bands is essentially flat, each time we expand the bandwidth on both sides by 1 kHz, we take in another 1% of the total power. Therefore, the occupied bandwidth of the hybrid IBOC signal is approximately 28 kHz.

The second adjacent issue has been noted in several areas of the country², and further

Need By Broadcasters

Many broadcaster and those in the industry who have commented believe that they need to have CD or FM fidelity in order to attract an audience and increase profitability.

I respectfully submit that IBOC (digital) is a technology issue that does not address a content issue that ultimately attracts listeners and revenue!

Many stations on the AM band are programming news and talk. I do not see any proof that by increasing the fidelity of these stations they would find increases in revenue or shares.

Even if stations were to program music content on digital medium wave, there is not supporting evidence to show that they would increase revenue or shares of listeners. FM listenership has eroded due to services such as Sirius, XM, Napster-like Internet downloading, and Internet Radio. In the case of Internet Radio, these services are even lower bit rates and quality levels from IBOC digital transmissions. Again, it's the programming of the stations and not the technology.

As the father of children in the age group of 10 to 18 years, and someone who has worked with the youth in the community, the reason that young citizens are gravitating to these

other services is because of content. If people don't like the content, they look towards other media. In my own case, I listen signals from stations in Columbus OH, Toledo OH, Detroit MI, Chicago IL, and even Windsor Ontario. I listen not for the clarity or fidelity, but because of the content.

I further suggest to the Commission that while the public has been responsive to the needs for better program content, they have not had any enthusiasm or need for digital. Analog has worked well for the American public for well our lifetime.

Solution to the Interference

We know that digital and analog transmissions can not peacefully coexist within the same block of frequencies.

Commission is setting a dangerous legal president that could impact other services and further erode the rights and choice of the public. The Commission would be placing a severe hardship on the backs of the American public by forcing IBOC digital on them.

I would like to urge the Commission to look into some alternative solutions to the digital issue.

1. Since the IBOC transmission adversely affects co-channel and adjacent channel transmissions of other medium wave stations outside the IBOC station's immediate service area, I would respectfully request that all analog stations in the X-Band be migrated inside the original core frequencies of 540 to 1600 kilohertz. The frequencies of 1620 to 1700 would then be used exclusively for digital transmission with a power no greater than needed to serve the immediate station's service area. 1610 would then be used as a guard channel against digital to analog adjacent channel interference.
2. Another option would be to provide another band of frequencies better suited for local digital broadcasting. Stations I have spoke to that operate IBOC say that they need to cover their "local area", often referred to as the Grade A. Grade B and beyond is irrelevant to stations. They don't care about listeners or revenues outside the local area. I would suggest that Commission institute a new band, perhaps called "DM", (digital modulation) in frequencies such as 512 to 532 megahertz, shared with digital TV broadcasters. Alternatively, 717.25 to

737.25 megahertz. These channels would be above the Commission's standard digital TV core and thus only affecting Channels 54 to 58. These frequencies technically favor local area while not offering the propagation interference issues of medium wave.

The Commission should also be aware that Kahn Communications is experimenting with CAM-D. Although I have noted many reports of interference from IBOC stations, I have not seen a single report of interference from a station operating Kahn CAM-D. I feel that in the interest of fairness, and acting in the interest of the public, the Commission should look into this technology as an alternative to IBOC. Cease all IBOC transmissions, and allow Kahn two years to prove his system.

Conclusion

The Commission, by allowing IBOC transmissions to continue, is putting the American people into a position of being forced to buy new radios or put up with unacceptable interference that has not been present since the dawn of broadcasting. There are billions of radios in the hands of citizens that are being rendered useless by pushing digital on a public not wanting the technology.

The Commission and the stations using the IBOC technology have an ethical responsibility when taking away something from the public.

The Commission should then take steps to prevent further interference and loss of the public's need for radio.

The Commission has long stated the "marketplace" stance. "Let the public decide" was the cry in Quad-FM, AM Stereo, and other technologies. Public decision is good, as long as the government or corporations are not forcing the public to accept the lesser of two evils. By placing all transmissions of digital radio in a separate band of frequencies, the public will have a choice not forced on them.

Many blind and physically handicapped people use radio as their first and only choice of information. Analog radio is the preferred entertainment media, and news source for people

commuting to work each day. Truckers listen to AM radio at great distances, as proven on over-night AM radio shows like Coast To Coast AM.

I urge the Commission to suspend any authorizations of terrestrial digital In Band On Channel (IBOC) digital audio broadcasting as proposed by iBiquity Digital Corporation in the AM radio band. Further, I feel the Commission should realize the danger in setting such a president.



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ⁱ IBOC white noise under WKHM-970 from WWJ-950 in Chelsea MI. IBOC white noise under WJKN-1510 from WSAI-1530 in Chelsea MI. IBOC white noise under WJYM-730 from WOR-710 in Holland OH (critical hours reception). IBOC white noise under WGHT-1500 caused by WZRC-1480 while driving on interstate 80 within the primary coverage area of WGHT.

ⁱⁱ iBiquity "Field Report / AM Nighttime Compatibility" dated October 31, 2003. Page 3, chart at bottom.

ⁱⁱⁱ Comments of Harry Helms, W7HLH. Mr. Helms holds an Amateur Extra License since 1978 and also holds a FCC general radiotelephone, GMDSS operator/maintainer, and second class radiotelegraph licenses.

^{iv} (1) each: Sony ICF-2010, GE SuperRadio III, Radio Shack 12-604, Sony ICF-42, and in dash Delco radio stock with 2001 Buick Century.

^v "Statement of Jeff Littlejohn" Senior Vice President of Engineering Services, Clear Channel Communications, Regarding AM IBOC Field Operations, Presentation to the NRSC, March 6th 2002.

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**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of:)	
)	
Digital Audio Broadcasting Systems)	MM Docket No. 99-325
And Their Impact on the Terrestrial)	
Radio Broadcast Service)	

Comments of Barry D. McLarnon, P. Eng.

I. INTRODUCTION

I am filing the following comments as an individual. I am a independent consultant and Professional Engineer, registered in the Province of Ontario. I have more than thirty years of experience in the analysis and design of communications systems, both analog and digital. My experience with digital broadcasting systems, primarily the Eureka 147 DAB system, dates back to the late 1980s.

II. NRSC-5 CHARTS A PATH WHICH HAS NOT BEEN PROPERLY STUDIED

With regard to NRSC-5, I would like to draw your attention to the fact that there are elements contained in this standard for which little or no test data has been filed on this docket. The Commission should be very careful not to authorize modes of operation utilizing these elements in the absence of information that clearly shows their impact. The most obvious elements in this category are the all-digital modes of operation. By approving NRSC-5, the Commission would be setting into motion an inexorable transitional path towards the use of these modes, despite the fact that they have not been

studied and evaluated in any depth. It would be irresponsible, and extremely poor spectrum management, to embark on a path with such far-reaching consequences without first conducting thorough systems studies.

It should be apparent to everyone by now that the most glaring flaw in the hybrid IBOC systems is that they are not “on channel”, and instead make use of first adjacent channels to transmit the digital signal. There seems to be a widespread notion that this is a temporary problem that will disappear in a future transition to all-digital operation, but an examination of NRSC-5 reveals that this would not be the case. Both all-digital systems will, by design, continue to transmit significant power outside their nominal channel limits. A transition to all-digital operation in the AM and FM broadcast bands is an opportunity to finally “get it right”, but this opportunity will be lost if this path to the digital future is prematurely set in concrete.

For the AM band, digital transmission holds the promise of expanded and more reliable coverage areas, especially at night. The key to this improvement is the major reduction in co-channel protection needed by a digital system compared to AM, and the virtual elimination of adjacent channel interference as a factor in determining coverage. This goal can be realized if the digital transmissions are confined to the 10 kHz bandwidth of an AM channel; however, the all-digital AM IBOC system specified in NRSC-5 has a bandwidth occupancy of 20 kHz. The consequence of this choice would be that the potential gains in nighttime coverage due to digital operation would be largely negated by co-channel interference emanating from first adjacent skywave signals. There is no technical reason why the digital signal cannot be restricted to the authorized channel. As a comparison, consider the DRM system, a worldwide open standard that

has modes utilizing only 10 kHz bandwidth that offer bit rates as high as 35 kb/s. This would clearly be a better choice for the AM band than the system specified in NRSC-5. I note that several major AM ownership groups are now pushing for a reduction in AM bandwidth to 10 kHz. It seems very ironic that these same groups are willing to embrace a future digital system in which the bandwidth reverts to 20 kHz. It is time to take a step back and do a thorough study to determine which digital system is best for the AM band in ITU Region 2. Similar considerations apply to the FM band.

III. UNTESTED ELEMENTS IN THE HYBRID MODES SPECIFIED IN NRSC-5

A more immediate concern with NRSC-5 are the hybrid modes that would be used during the remainder of this decade, and probably for much longer than that. As I have pointed out in previous comments¹, compatibility of the hybrid IBOC systems with analog reception was characterized using a woefully inadequate sampling of receivers. Despite this shortcoming, the test results showed that certain receivers showed significant degradation in signal-to-noise ratio (SNR) when hybrid IBOC was added to the desired AM or FM station.

The AM IBOC system, as described in the NRSC-5 normative reference documents SY_IDD_1012s and SY_IDD_1082s, includes a Power Level control to set the relative power levels of the secondary and tertiary sidebands. The diagrams in SY_IDD_1012s depicting the hybrid spectrum (Figures 5-1 and 5-2) *show the effects of the low power setting only*. The high power setting increases the power of all digital subcarriers within 10 kHz of the carrier frequency by 6 dB, with the exception of the

¹ Comments of Barry D. McLarnon, dated June 14, 2004; Reply Comments of Barry D. McLarnon, dated July 15, 2004.

subcarriers below 2.5 kHz, where the increase is reduced on a sliding scale. It appears that all test results thus far released by iBiquity were obtained using the low power setting of this control. The high power setting has the potential to cause further SNR degradation in susceptible AM receivers, and thus should not be authorized in the absence of thorough test results in which this setting was used. In any future receiver tests, an adequate sampling of receivers should also be used.

The FM IBOC system, as described in the NRSC-5 normative reference documents SY_IDD_1011s and SY_IDD_1026s, includes three Extended Hybrid modes (MP2, MP3 and MP4) that specify the addition of digital subcarriers in the region between 101 and 129 kHz offset from the FM carrier frequency (i.e., closer to the analog signal than the standard hybrid mode subcarriers). No test results for any of these extended modes have been released by iBiquity. However, some limited test results for the MP3 mode have recently been submitted by NPR². Several of the tested receivers showed significant decreases in SNR of up to 6 dB when the IBOC mode was changed from MP1 (standard hybrid) to MP3. Unfortunately, there are no results showing how much the SNR of these receivers are already degraded by going from FM alone to MP1 IBOC mode. These tests were quite limited in scope, but they do demonstrate a compatibility problem with a class of analog receivers that is quite sizable. Clearly, transmissions using the extended hybrid modes should not be authorized until further compatibility tests are conducted, and here again, the sample population of receivers tested should be much larger than has been the case to date.

² *Host Compatibility Measurements for the Extended Hybrid Mode of IBOC Digital Audio Broadcasting*, National Public Radio, October 29, 2004.

IV. THE TRUE NATURE OF HYBRID IBOC HAS BEEN MISREPRESENTED

In addition to the concerns voiced above, I continue to have serious misgivings about the impact on the AM and FM bands of operating the hybrid systems described in NRSC-5. As I have stated previously, the proponents and evaluators of these systems have not provided an accurate and unbiased assessment of their potential to interfere with existing analog services. Many commenters on this docket have explained the fallacy behind using an emission mask, intended to contain transient analog modulation products, to “hide” a continuous duty cycle digital signal having a much higher average power. Moreover, that signal occupies adjacent channels, thus completely negating the Commission’s desire to endorse digital radio systems that are “on channel”. I will summarize briefly my previous comments on bandwidth occupancy of the hybrid IBOC signals, none of which have been refuted by proponents of those systems.

The occupied bandwidth of a signal has a well-defined engineering meaning that is codified in 47CFR§2.202. Using the same mathematical model for the FM signal that has been used in the past for IBOC system analysis, it is easy to show that adding hybrid IBOC at the -20 dBc digital power level specified in NRSC-5 increases the occupied bandwidth by 100%. It is also possible to calculate the average power deposited into a first adjacent channel, before and after adding hybrid IBOC. This calculation shows that the addition of hybrid IBOC to an average FM signal increases the interference power in a first adjacent channel by 16 dB.

My measurements on several AM stations that follow the NRSC-1/NRSC-2 standards showed that the occupied bandwidths (again, as defined in 47CFR§2.202) are actually quite small, in the 1.0 to 1.25 kHz range. When hybrid IBOC as specified in

NRSC-5 is added to the AM signal, however, the occupied bandwidth increases dramatically, to about 28 kHz. Therefore, hybrid IBOC increases the occupied bandwidth of the AM signal by a factor of about 25, or 2400%. I also measured the average power deposited into the first adjacent channels by these stations, and then calculated how it would change with the addition of hybrid IBOC. For the three stations measured, adding hybrid IBOC would increase the interference power in a first adjacent channel by an amount ranging from 18 to 39 dB.

V. INTERNATIONAL AGREEMENTS AND PROTECTION

It should be abundantly clear that operation of the hybrid AM IBOC system as defined in NRSC-5 is not permissible under the terms of several international agreements dealing with AM broadcasting, including Rio 1981, USA-Canada 1991, and USA-Mexico 1987. See, for example, Section 4.2 ("Class of emission") of the Rio agreement. It would be presumptuous and arrogant for a country that is signatory to those agreements to authorize the use of such emissions without first obtaining the agreement of the other signatory countries to make appropriate amendments to the agreements.

Many commenters on this docket have pointed out that the adjacent channel usage of the hybrid IBOC system makes a mockery of existing protection rules, but there still seems to be a lack of appreciation of how grave this problem really is. It should be obvious that the digital components of hybrid signals should be treated as separate entities in interference analysis. One factor that is usually overlooked, however, is that interference to analog from a digital source cannot be equated directly to an analog interference source having the same power. This is particularly true for AM signals,

where the majority of the power is in the carrier and therefore does not contribute to audible co-channel interference, provided that the frequency offset between the carriers is small. Fortunately, we have a useful reference point for this situation in the DRM system. A DRM emission and an AM IBOC sideband having similar bandwidth are virtually indistinguishable, since they use the same type of modulation and would have equivalent effects on an AM detector. Studies by the ITU have determined that in order to provide the same level of protection to a co-channel analog station, a DRM station must operate at 6 to 7 dB lower average power than the carrier power of an AM station assigned to that channel. Turning this around, we can say that a conservative estimate of the interference caused by a co-channel primary AM IBOC sideband is equivalent to that caused by an AM station having 6 dB higher power. In other words, we must add at least 6 dB (ITU-R Recommendation BS.1615 specifies 7 dB) to the co-channel protection rules when the interfering signal is digital.

Consider second adjacent protection. Stations in the US are required to provide protection to second adjacent stations in Canada and Mexico such that the D/U (desired/undesired) ratio on their protected 0.5 mV/m contours (0.1 mV/m in the case of Class A stations during daytime), within the borders of those countries, is no lower than -29.5 dB. First adjacent protection is 0 dB D/U. However, a second adjacent hybrid IBOC station creates a first adjacent primary digital sideband that is only 16 dB down. If the station is just at the -29.5 dB second adjacent protection limit, then its first adjacent digital signal is at -13.5 dB D/U, or 13.5 dB in excess of the first adjacent protection level. The nature of the digital signal, as explained above, makes the interference even worse than if it came from an AM first adjacent signal at that excessive level. Even if the

primary digital sideband power is reduced by 6 dB, as suggested for interference mitigation in the Commission's interim rules for IBOC operation, this still falls well short of solving the problem. The preceding example highlights the potential for cross-border second adjacent interference from hybrid IBOC, but instances of domestic interference of this type will be far more numerous. A number of reports of such interference in daytime hybrid IBOC operation have already come to light, and this is just the tip of the iceberg, since only about 1.4% of the nation's AM stations are using hybrid IBOC so far.

The nighttime first adjacent interference problem is even worse, since it will affect more stations. There is no protection from first adjacent skywave signals, so stations are at the mercy of first adjacent stations that convert to hybrid IBOC. Class A stations, with their 0.5 mV/m nighttime protected contours, plus those Class B stations that have a reasonably low NIF contour, are the ones that will suffer the most damage. First adjacent skywave signals of the order of 0 dB D/U are common on these contours at night, though the D/U ratios may fall significantly lower than that. Most AM receivers have little difficulty delivering a listenable signal under these circumstances. However, if a first adjacent station at 0 dB D/U goes IBOC, it creates a co-channel interfering signal at 16 dB D/U. As explained above, we must also include an additional 6 dB factor to allow for the fact that the interfering signal is digital, so the interference is actually approximately equivalent to that of a co-channel AM station at 10 dB D/U. This is 16 dB more than would be permitted by the co-channel protection rules, and would completely destroy reception on the "protected" contour. Here again, a 6 dB reduction in primary digital sideband power would not solve this problem. There would still be a 10 dB shortfall in protection, and badly impaired reception near the protected contours of the

affected stations.

VI. CONCLUSION

In the light of these facts, it is simply amazing that AM IBOC deployment has been allowed to proceed this far. In other parts of the world, such poor engineering and spectrum management would be regarded as a joke. It is time to call a moratorium on this deployment, and begin a study to find a more reasonable means of transitioning to digital operation in the AM broadcast band.

The hybrid FM IBOC system also has some serious problems, but since it is the lesser of the two evils and has fewer international implications, I have chosen not to expound at length on them. I do sound a note of caution, however, with regard to authorizing operation with those modes described in NRSC-5 which are largely untested.

For both the AM and FM bands, adoption of the NRSC-5 standard would establish a *de facto* path towards adopting all-digital systems that have thus far seen very little scrutiny. The use of these systems would have far-reaching consequences that have been completely unexplored up to this point. Rather than lock into such a path, the Commission should instead be collaborating with other Region 2 countries to conduct comprehensive systems studies to determine the best usage for these broadcasting bands in the new era of digital transmission.

Respectfully submitted,

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Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of:)
)
Digital Audio Broadcasting Systems) MM Docket No. 99-325
And Their Impact on the Terrestrial)
Radio Broadcast Service)

Comments of Reunion Broadcasting, L.L.C.

The following comments are filed by the undersigned in response to the Commission's request for comments on "In-Band/On Channel Digital Radio Broadcasting Standard, NRSC-5", public notice DA 05-0661. While the proposed standard impacts FM as well as AM broadcasters, these comments are limited to the impact of the proposed standard on existing and future AM operations.

The Proposed NRSC-5 Standard Cannot Legitimize Increased Interference to Existing Stations.

Throughout this proceeding, Reunion has supported the rapid deployment of spectrum efficient digital broadcasting in the AM band. However, Reunion respectfully objects to the proposed NRSC-5 standard to the extent that AM operation under the proposed standard would result in increased interference to existing stations.

Somewhere in this proceeding, the cart has overtaken the horse. In haste to introduce new technology, someone, somewhere, has persuaded policy makers that the proposed iBiquity "IBOC" system produces sufficient benefits to outweigh the significant interference it introduces into adjacent AM channels. In the initial order authorizing interim hybrid operation, the Commission apparently acknowledged the increased interference that hybrid operation would